

be our aim to show that acceptable color prints can be made without this equipment or this knowledge.

The average amateur will find that by entering the field of color printing he will not only derive a great deal of satisfaction from being able to produce prints in full color, but that the enforced accuracy with which he must work will improve his black-and-white photography immeasurably. We will attempt to make whatever scientific explanations are necessary so simple that any reasonably advanced amateur will find this a practical working manual.

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We now have a print in natural color. The inks manufactured for this purpose are sometimes not satisfactory enough to give a good, rich print with three colors. Therefore, you can employ a fourth color—black—to give the print depth and brilliance. If you have a set of three separation negatives, you can make a very thin print from the red-filter negative on the process film. Process it as the others, but ink it up with a special black ink. Do not touch the surface of the final print until it is perfectly dry. This will take some time, depending upon the humidity and temperature of your surroundings.

The materials and special tools, including inks and chemicals, can be bought from the Chemical Supply Company, Hollywood, Calif., under the name of Champlin-color Kit. Additional material needed is the Agfa Process film. Another brand of ink can be bought from Charles H. Parkington, 2780 Highland Ave., Norwood, Cincinnati, Ohio. A set of tricolor red, blue and yellow costs \$2.10, and with the addition of warm black, \$3.15.

CHAPTER X

TRICOLOR PRINTING WITH DYE-COUPLED COLOR DEVELOPERS

RECENTLY there have appeared in magazines several articles on tricolor printing with dye-coupled color developers, a more or less unfamiliar method of making tricolor prints. We have tried it with moderate success. The basic principle of dye-coupling is in a way simple. Black-and-white prints are developed in a solution similar to the usual formulas but containing chemicals which, during the development, convert the metallic silver image into a salt which can be replaced automatically by an insoluble organic dye. This reaction is produced through the oxidation products obtained between a developing agent and certain substances in the developer or emulsion.

For tricolor printing, use a stripping film like Chromatone printing paper. After making the various tests to establish the exposure ratio, develop the three positives separately in the following solutions:

Basic Developer

Stock Solution:	
Sodium sulfite	18.00 grams
Sodium carbonate	40.0 grams
Potassium bromide	1.0 gram
2-amino-5-diethylaminotoluene monohydrochloride	1.5 grams
Water to make	1.0 liter

More or less quantity of the developing agent increases or decreases the strength and contrast of the print respectively. Too much developer will result in the production of general stain.

Color Formers

Magenta coupler	
P-nitrophenylacetonitrile	1.0 gram
Acetone to make	100.0 cc
Cyan or blue-green coupler	
2,4-dichloro-1-naphthol	1.0 gram
Acetone to make	100.0 cc
Yellow coupler	
Acetone 2, 5 dichloroanilide	1.0 gram
Acetone to make	100.0 cc

In developing the positives, mix one part of the appropriate color former with 10 parts of the basic develop-

ing solution. This combined developer should be used immediately. Develop the prints for at least three minutes, then rinse them in running water for about one minute. Next immerse them for about fifteen minutes in the following fixing bath:

Sodium sulfite.....	40.0 grams
25% Hypo solution.....	1.0 liter
Formaldehyde.....	100.0 cc

The resulting images consist of both silver and dye. The silver is removed by bleaching the prints in Farmer's reducer. The colors are brightened by the removal of the silver, but the contrast of the print is lowered. This should be taken into account when preparing the developer. Contrast can also be increased by increasing the developing time, just as in black-and-white printing.

After washing, the three stripfilms are assembled in register as in the Chromatone process. The order of assembly is as follows—first the yellow, then the magenta, and then the blue-green.

Tricolor Bleach-Out Process

This process employs a paper which is covered with three emulsions, each dyed with one of the subtractive colors. These dyes can easily be bleached out by absorption of their complementary colors when exposed to light in contact with a color transparency. In this way a natural color photograph is obtained. Before exposure this paper will naturally look black. To stabilize the dyes after exposure they are fixed in a special fixing solution.

Load the paper and the color transparency in a printing frame under subdued light. A very long exposure is needed even when using a No. 2 Photoflood placed 6 inches from the printing frame. An electric fan is used to eliminate excessive heat. To inspect the progress, one side of the hinged back of the printing frame is opened in subdued light. The safe-edge color determines the correct exposure, and should be light cream; or you can rely on your judgment by looking at the print in subdued light to observe its density.

After proper exposure, sometimes taking more than one hour, the print is put into a special fixing bath. Agitate the print for at least one minute and leave it in the bath for one hour, checking frequently that the print is well covered with solution. Washing afterward in plain water should not take longer than two or three minutes. The print is then surfaced-cleaned with absorbent cotton, then dried between several blotters. The print can be ferrotyped if a glossy surface is desired.

Paper and fixing bath can be purchased from the Vitachrome Film Corporation.

Manufacturers and Distributors of Color Equipment

Color photography and color printing continues to become more and more popular in the amateur field. Likewise, supplies and equipment are being stocked by local photo supply dealers, particularly in the larger cities. For the benefit of readers who are unable to obtain materials through their local dealers, this list of manufacturers and distributors has been included.

Tricolor Pigment Process

Devin-McGraw Colorgraph Co., 175 So. Verdugo Ave., Burbank, Calif.

Manufacturers of tricolor cameras, tricolor pigment papers and monochrome carbon papers. Devin Bromide Paper, and all supplies for this process.

National Photocolor Corp., 305 E. 43rd St., New York, N. Y.
Manufacturers of tricolor cameras, tricolor pigment papers, and all supplies for pigment printing.

George Murphy, Inc., 57 E. 9th St., New York, N. Y.
Distributors for Autotype Carbon and Carbro tissues and sundries, and tricolor cameras.

Caron Color Process

Caron Color Company, Detroit, Mich.

Chromatone Process

Defender Photo Supply Company, Inc., Rochester, N. Y.

Neotone and Orthotone

Thomas S. Curtis Laboratories, 2063 East Gage Ave., Huntington Park, Calif.

Also cameras, color printer, etc.

Imbibition Printing

Eastman Kodak Company, Rochester, N. Y.

Supplies for Wash-Off Relief Process

Defender Photo Supply Company, Inc., Rochester, N. Y.

Chroma-Relief Film and Backing Paper.

Thomas S. Curtis Laboratories; see Neotone.

Supplies for Curtis Orthotone Process

Condax-Speck, Inc., 323 East 47th St., New York, N. Y.

Dyetrol dyes and transfer papers

Tricol Color Products, 18 E. 42nd St., New York, N. Y.

Chromax dyes, transfer paper, and all supplies for imbibition printing.

Tricolor Bromoil Printing

Chemical Supply Co., 6324 Santa Monica Blvd., Hollywood, Calif.

Distributors for Champlincolor

Charles H. Parkington, 2780 Highland Ave., Norwood, Cincinnati, Ohio.

Distributor for Signal Bromoil Inks

Dye-Coupled Developers

Eastman Kodak Company, Organic Chemical Division, Rochester, N. Y.

Developing agents and color formers

Tricolor Bleach-out Process

Vitachrome Film Corporation, 1150 Columbus Ave., Boston, Mass.

Vitachrome paper and fixing solution.